Variance Paper:

"A Pricing Model for Underinsured Motorist Coverage"

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HAPPY VICTORIA DAY!!!

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Underinsured Motorist (UIM) Coverage

- Component of most personal automobile policies in many states & provinces
- First-party coverage
- Covers the amount of a liability claim by the insured or an immediate family member in excess of the third party's liability limit & less than the insured's UIM limit
- Insureds typically purchase UIM coverage up to their own liability limit

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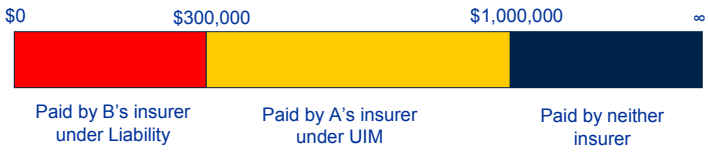
Underinsured Motorist (UIM) Coverage

- Example:
  - Driver A has a policy with $1,000,000 liability and $1,000,000 UIM
  - Driver B has a policy with $300,000 liability
  - B is liable to A for damages as a result of a collision



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Traditional Ratemaking Approaches for UIM

- 2007 Ontario industry experience for UIM:

Earned exposures	6.2 million
Incurred claim count	290
Frequency	0.005%
Severity mean	$280,748
Severity CV (estimated)	2.50
Loss cost credibility (estimated)	19%

- Becomes even less credible when looking at claims for a particular UIM limit (to calculate increased limit factors)

Data source: General Insurance Statistical Agency, Automobile Insurance Experience Report AU10-N, 2007. Used with permission.

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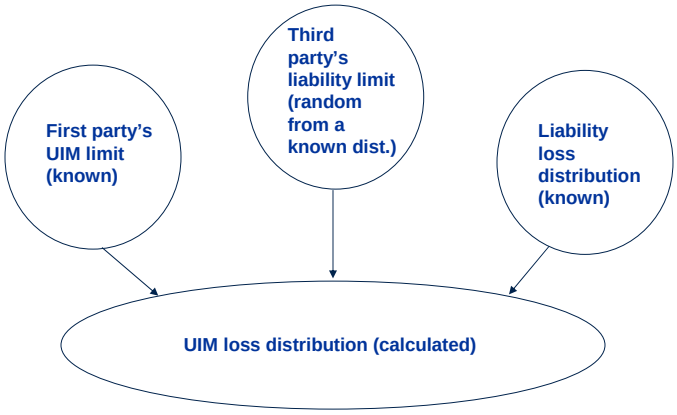
An Alternative Pricing Model – The Concept



- UIM acts as a temporary upgrade to the third party's liability limit, where the third party is a randomly selected member of the driving population

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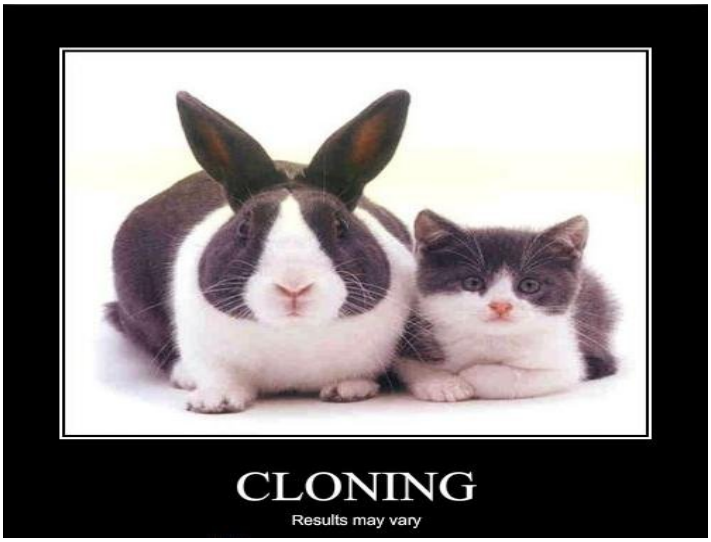
Your Results May Vary!



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Your Results May Vary!

- Coverage laws in Ontario that are relevant to UIM:
  - All vehicles must carry a minimum of $200,000 liability coverage
  - When the third party is uninsured, damages are paid by a separate Uninsured Automobile coverage up to the statutory minimum limit of $200,000
  - Insurers have the right to reduce claimants' liability limits to the statutory minimum of $200,000 on claims where the policyholder was in violation of the policy conditions during the incident
- Consult the coverage laws of the jurisdiction for which you are pricing!

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An Alternative Pricing Model

- Given the following fictitious data and assumptions:
  - Indicated loss cost for liability is $300
  - Liability limit relativities:

Table 1. Example liability limit relativities

Limit	Industry Exposure Distribution	Indicated Relativity
$200,000	2%	1.000
$300,000	5%	1.150
$500,000	10%	1.300
$1,000,000	65%	1.600
$2,000,000	18%	1.900
Average		1.5895

  - 2% of drivers are uninsured
  - 5% of all claims are associated with policy violations
  - Loading for expenses, risk and profit is 15% of premium

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Step 1 – Net Liability Loss Cost

- Loss cost @ each limit:

$$\mathrm{NLLC}_n = \mathrm{LiaLC} \times (\mathrm{LCRel}_n / \mathrm{LCRel}_{\mathrm{avg}}) \qquad (3.1)$$

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Step 1 – Net Liability Loss Cost

- Loss cost @ each limit:

$$
\begin{aligned}
&\mathrm{NLLC}_{200,000} \\
&\quad = \mathrm{LiaLC} \times (\mathrm{LCRel}_{200,000} / \mathrm{LCRel}_{\mathrm{avg}}) \\
&\quad = 300 \times (1.000 / 1.5895) \\
&\quad = 188.74.
\end{aligned}
$$

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Step 1 – Net Liability Loss Cost

- Loss cost @ each limit:

Table 2. Calculated net liability loss costs for each limit

Limit	Net Liability Loss Cost
$200,000	188.74
$300,000	217.05
$500,000	245.36
$1,000,000	301.98
$2,000,000	358.60

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Step 2 – Cost of Limit Increase

- For each possible combination of the first party's UIM limit and the third party's liability limit, determine the average annual cost of increasing the third party's liability coverage to match the first party's UIM limit

$$\text{Inc}_{mN} = \max\{\text{NLLC}_m - \text{NLLC}_N, 0\} \quad (3.2)$$

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Step 2 – Cost of Limit Increase

- For each possible combination of the first party's UIM limit and the third party's liability limit, determine the average annual cost of increasing the third party's liability coverage to match the first party's UIM limit

Table 3. Cost of increasing third party's liability limit

	Third Party's Liability Limit				
First Party's UIM Limit	$200,000	$300,000	$500,000	$1,000,000	$2,000,000
$200,000	0.00	0.00	0.00	0.00	0.00
$300,000	28.31	0.00	0.00	0.00	0.00
$500,000	56.62	28.31	0.00	0.00	0.00
$1,000,000	113.24	84.93	56.62	0.00	0.00
$2,000,000	169.86	141.55	113.24	56.62	0.00

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Step 3 – Adjusted Limit Distribution

- Start with the industry liability limit distribution
- Adjust for:
  - Claims where the third party's limit is reduced to $200,000 due to a policy violation
  - Claims where the third party is uninsured

$$P_n = P(N = n)$$
$$= \begin{cases} D_n \times (1 - V - U) + V + U & \text{if} \quad n = 200{,}000 \\ D_n \times (1 - V - U) & \text{if} \quad n \neq 200{,}000 \end{cases}$$
$$(3.3)$$

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Step 3 – Adjusted Limit Distribution

- Start with the industry liability limit distribution
- Adjust for:
  - Claims where the third party's limit is reduced to $200,000 due to a policy violation
  - Claims where the third party is uninsured

$200,000: $0.02 \times (1 - 0.05 - 0.02) + 0.05 + 0.02 = 0.0886.$

$300,000: $0.05 \times (1 - 0.05 - 0.02) = 0.0465.$

$500,000: $0.10 \times (1 - 0.05 - 0.02) = 0.0930.$

$1,000,000: $0.65 \times (1 - 0.05 - 0.02) = 0.6045.$

$2,000,000: $0.18 \times (1 - 0.05 - 0.02) = 0.1674.$

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Step 4 – UIM Loss Cost

- The expected cost of the limit increase (from Step 2) over the adjusted limit distribution (from Step 3)

$$\text{UIMLC}_m = \text{sum}\ (\text{Inc}_{mn} \times P_n), \quad \text{over all } n. \tag{3.4}$$

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Step 4 – UIM Loss Cost

- The expected cost of the limit increase (from Step 2) over the adjusted limit distribution (from Step 3)

Table 4. Cost of increasing third party's liability limit, with limit distribution

	Third Party's Liability Limit [Adjusted Distribution]				
First Party's UIM Limit	$200,000 [0.0886]	$300,000 [0.0465]	$500,000 [0.0930]	$1,000,000 [0.6045]	$2,000,000 [0.1674]
$200,000	0.00	0.00	0.00	0.00	0.00
$300,000	28.31	0.00	0.00	0.00	0.00
$500,000	56.62	28.31	0.00	0.00	0.00
$1,000,000	113.24	84.93	56.62	0.00	0.00
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Step 4 – UIM Loss Cost

- The expected cost of the limit increase (from Step 2) over the adjusted limit distribution (from Step 3)

Table 5. Indicated loss cost and indicated premium for each limit

Limit	Indicated Loss Cost	Indicated Premium
$200,000	0.00	0.00
$300,000	2.51	2.95
$500,000	6.33	7.45
$1,000,000	19.25	22.65
$2,000,000	66.39	78.11

Additional Considerations

- **Loss Adjustment Expenses**
  - Liability loss costs (input to the model) will usually include LAE
  - Limits apply to indemnity only → LAE portion of the liability claim carries no UIM exposure
    - But the UIM claim itself will incur some (smaller) settlement costs
  - Use liability loss costs excl. LAE as an input to the model, if available
    - Can then add a LAE margin as part of the expense / profit loading

Additional Considerations

Liability Limit Distribution

- Model assumes that the at-fault third party is a randomly selected member of the driving population
- Is the at-fault claim frequency of a driver with $2,000,000 liability the same as that of a driver with $200,000 liability?
- Could use a conditional distribution for the third party's limit
  - Bayes' Theorem

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Additional Considerations

Data Accuracy

- Some systems mix UIM claims data with liability claims data
  - Liability loss cost becomes overstated
- Modeled UIM claim cost should be subtracted from the mixed liability/UIM claim cost
  - Liability claim cost is used as an input to the UIM model
  - Iterative approach may be required

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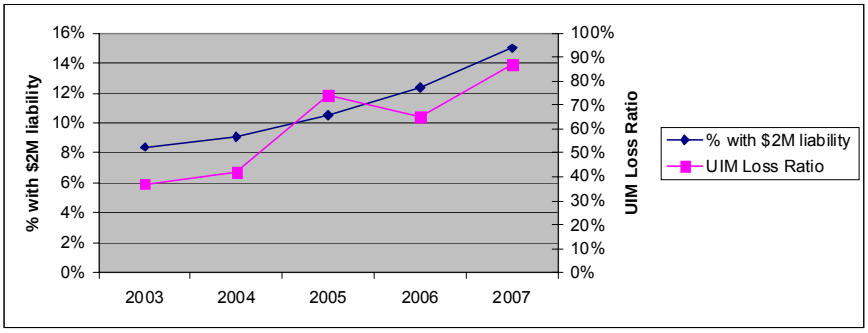
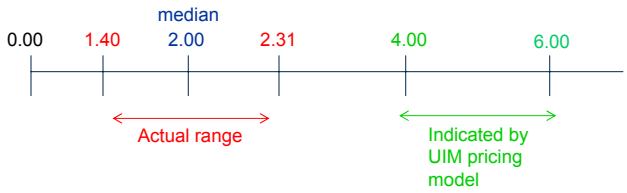
Ontario Private Passenger Industry Experience



Data source: General Insurance Statistical Agency, Automobile Insurance Experience Report AU10-N, 2007. Used with permission.

Ontario Private Passenger Industry Experience

- **What is causing the deterioration in UIM rate adequacy?**
  - Look at the ratio:
    (UIM rate @ $2,000,000 limit) / (UIM rate @ $1,000,000 limit)
  - Ratios for 16 major Ontario insurers:



Conclusions

- As the marketplace moves towards increased liability limits, UIM rate adequacy may become a more significant issue
- With traditional ratemaking approaches, pricing responses will be less than adequate – and they will fail to distinguish accurately and fairly between different levels of exposure
- The UIM pricing model provides a relatively simple and accurate way to price "derivative" coverages

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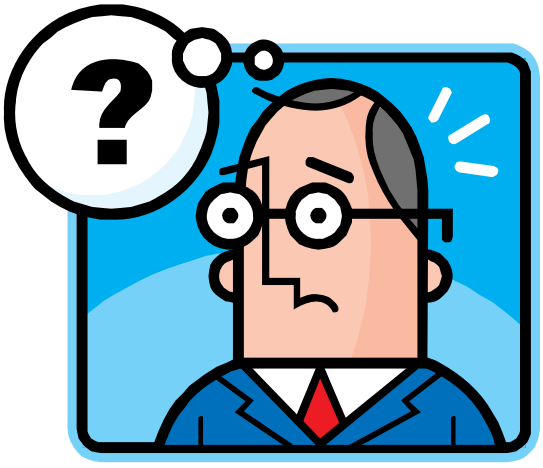
Questions?



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